



ATTACHMENT 2

AIRWORTHINESS GROUP CHAIRMAN'S FACTUAL REPORT

CEN13FA121

**Type Certificate Data Sheet No. E00054EN Revision 8
for Turbomeca Arriel Engines
(9 pages)**

PRINCIPAL DIMENSIONS: (continued)

INCHES (M)	ARRIEL 2C	ARRIEL 2C1	ARRIEL 2C2	ARRIEL 2D	
Length	46.5 (1.181)	39.9 (1.015)	39.9 (1.015)	46.34 (1.177)	
Width	19.6 (0.498)	19.6 (0.498)	19.6 (0.498)	19.68 (0.500)	
Height	24.25 (0.616)	22.6 (0.576)	22.6 (0.576)	24.25 (0.616)	

CENTER OF GRAVITY: REFER TO INSTALLATION MANUAL

MAXIMUM DRY WEIGHT: Refer to engine manual for definition of dry weight

LBS. (KG)	ARRIEL 2S1	ARRIEL 2S2	ARRIEL 2B	ARRIEL 2B1	
	289 (131.2)	289 (131)	295 (133.9)	291.5 (132.2)	
	ARRIEL 2C	ARRIEL 2C1	ARRIEL 2C2	ARRIEL 2D	
	289 (131.1)	285 (129.2)	290 (131.5)	293 (132.9)	

DRIVE SHAFT TYPE: REFER TO INSTALLATION MANUAL

IGNITION: Low tension, high energy system, including:
 1 high-energy (H.E.) ignition unit
 2 ignition cables
 2 igniter plugs

STARTING: The automatic starting sequence is ensured by the Engine Electronic Control Unit. For detail, see Installation Manual.

CERTIFICATION BASIS: FAR Section 21.29 and 33, Amendments 33-1 through 33-14; and for Arriel 2S1 and Arriel 2C Special Condition No. SC-33-ANE-05 published on April 15, 1996. For Arriel 2C2 and Arriel 2S2, FAR 33, Amendment 1 through 14, FAR 33.28, Amendment 15, Special Conditions 33-ANE-05 and 33-001-SC published June 19, 1998. For Arriel 2D, 14 Code of Federal Regulation Part 33, Amendments 33-1 through 33-15 and Special Condition No. 33-009-SC, published May 27, 2011.

MODEL	APPLICATION DATE	TYPE CERTIFICATE ISSUED / AMENDED	TYPE CERTIFICATE CANCELLED
ARRIEL 2S1	02/25/94	06/10/96	
ARRIEL 2B	04/28/97	05/06/98	
ARRIEL 2C	04/28/97	05/06/98	
ARRIEL 2C1	11/27/97	09/24/99	
ARRIEL 2B1	12/13/98	12/1/00	
ARRIEL 2C2	09/12/99	01/10/03	
ARRIEL 2S2	03/9/04	12/13/05	
ARRIEL 2D	8/26/10	07/12/11	

The aviation authority for France, the Direction Generale de L'Aviation Civile (DGAC), originally type certificated this engine. The FAA validated this product under U.S. Type Certificate Number E00054EN. Effective September 28, 2003, the European Aviation Safety Agency (EASA) began oversight of this product on behalf of France.

PRODUCTION BASIS: ARRIEL 2S1 and 2S2: Production Certificate Number 5SW. Produced by Turbomeca USA in the United States under license agreement from Turbomeca S.A., France.

ARRIEL 2S1 and 2S2: Engine modules, and parts thereof, produced by Turbomeca S.A., France, conforming to this type certificate are fully interchangeable with ARRIEL 2S1 and 2S2 engine modules, and parts thereof, produced under Production Certificate Number 5SW.

Engines manufactured under Production Certificate Number 5SW shall have the suffix "TEC" added to the engine serial number and shall be included in the required identification data as specified by FAR Section 45.

IMPORT REQUIREMENTS:

To be considered eligible for installation on U.S. registered aircraft, each new engine to be exported to the United States with the DGAC or EASA airworthiness approval shall have a Joint Aviation Authorities (JAA) or EASA Form 1, Authorized Release Certificate. The JAA or EASA Form 1 should state that the engine conforms to the type design approved under the U.S. Type Certificate E00054EN is in a condition for safe operation and has undergone a final operational check.

NOTES

NOTE 1. MAXIMUM PERMISSIBLE ENGINE SPEEDS / RPM

A. GAS GENERATOR SPEED (N1)					
	ARRIEL 2S1	ARRIEL 2S2	ARRIEL 2B	ARRIEL 2B1	
30 second OEI rating	55156	55178	---	---	
2 minute OEI rating	53386	53348	---	---	
Continuous OEI rating	52756	52776	---	---	
Takeoff rating	52756	53089	52756	52756	
Maximum continuous rating	51616	51959	50672	50312	
30-minute rating	52756	53089	---	---	
	ARRIEL 2C	ARRIEL 2C1	ARRIEL 2C2	ARRIEL 2D	
30 second OEI rating	55051	54986	55265	---	
2 minute OEI rating	53192	53126	53275	---	
Continuous OEI rating	52571	52506	52764	---	
Takeoff rating	52660	52776	53079	53086	
Maximum continuous rating	51520	51637	51922	52050	
30-minute rating	---	---	53079	53086	
For variation of these limits with outside air temperature (OAT), refer to Installation Manual. For required action if limits are exceeded, refer to Maintenance Manual. 100% = 52,110 rpm					
B. POWER SHAFT SPEED (N2)					
	ARRIEL 2S1	ARRIEL 2S2	ARRIEL 2B	ARRIEL 2B1	
Minimum stabilized	35381	--	--	--	
Maximum transient (<20 sec)					
power on	42613	--	--	--	
power off	47305	--	--	--	
Maximum stabilized	42418	--	--	--	
	ARRIEL 2C	ARRIEL 2C1	ARRIEL 2C2	ARRIEL 2D	
Minimum stabilized	35381	33230	35381	35437	
Maximum transient (<20 sec)					
power on	42613	--	--	42613	
power off	47305	--	--	46598	
Maximum stabilized	42418	--	--	42477	
If limits are exceeded, refer to Maintenance Manual. 100% N2 = 39,095 rpm for all Models except Arriel 2D 100% N2 = 39,158 rpm for Arriel 2D					

NOTE 2. MAXIMUM PERMISSIBLE TEMPERATURE

A. EXHAUST GAS T45, Measured with 8 thermocouples on gas generator turbine diffuser (Degrees °C)					
	ARRIEL 2S1	ARRIEL 2S2	ARRIEL 2B	ARRIEL 2B1	
30 second OEI rating	1000	996	---	---	
2 minute OEI rating	941	944	---	---	
Continuous OEI rating	912	926	---	---	
Takeoff rating	912	930	915	915	
30 minute rating	912	930	---	---	
Max. continuous rating	877	893	849	849	
Starting (<10 seconds)	865	840	865	--	
Starting (unlimited)	750	--	--	--	

NOTE 2. (continued)

MAXIMUM PERMISSIBLE TEMPERATURE

A. EXHAUST GAS T45, Measured with 8 thermocouples on gas generator turbine diffuser (Degrees °C)				
	ARRIEL 2C	ARRIEL 2C1	ARRIEL 2C2	ARRIEL 2D
30 second OEI rating	1000	--	996	---
2 minute OEI rating	941	--	944	---
Continuous OEI rating	912	--	926	---
Takeoff rating	912	--	929	962
30 minute rating	---	---	929	962
Max. continuous rating	877	--	891	918
Starting (<10 seconds)	865	--	840	840
Starting (unlimited)	750	--	--	---
If limits are exceeded, refer to Maintenance Manual for required action.				
B. OIL, Measured at engine inlet				
Minimum oil temperature for engine starting:	-30°C for oil with a kinematic viscosity of 5.4×10^{-5} ft ² /sec. -50°C for oil with a kinematic viscosity of 3.2 to 4.2×10^{-5} ft ² /sec.			
Minimum oil temperature for power-up:	0°C for oil with a kinematic viscosity of 5.4×10^{-5} ft ² /sec. -10°C for oil with a kinematic viscosity of 3.2 to 4.2×10^{-5} ft ² /sec.			
Maximum oil temperature for all Models except Arriel 2D:				115°C
Maximum oil temperature for Arriel 2D (measured at a different location from other Models)				117°C
C. FUEL, Measured at engine inlet				
1. Maximum temperature: REFER TO INSTALLATION MANUAL				
2. Minimum temperature: REFER TO INSTALLATION MANUAL				
3. For 2S1, 2B, 2B1, 2C, 2C1 and 2D: Use of anti-icing additive for fuel temperature <-20°C For 2C2 and 2S2: Use of anti-icing additive for fuel temperature <-30°C				
4. Starting: REFER TO INSTALLATION MANUAL				

NOTE 3

POWER TURBINE UNIT TORQUE LIMITS / FOOT - POUND (daNm)

	ARRIEL 2S1	ARRIEL 2S2	ARRIEL 2B	ARRIEL 2B1	
30 second OEI rating	885 (120)	--	---	---	
2 minute OEI rating	833 (113)	--	---	---	
Continuous OEI rating	756 (102.5)	--	---	---	
Takeoff	682 (92.5)	--	654 (88.7)	682 (92.5)	
Maximum continuous	682 (92.5)	--	654 (88.7)	682 (92.5)	
Max. over-torque (≤ 20 sec)	1055 (143)	--	975 (132.2)	975 (132.2)	
30-minute rating	682 (92.5)	--	---	---	
	ARRIEL 2C	ARRIEL 2C1	ARRIEL 2C2	ARRIEL 2D	
30 second OEI rating	861 (116.8)	875 (118.7)	880 (119.3)	---	
2 minute OEI rating	791 (107.3)	796 (107.9)	856 (116.0)	---	
Continuous OEI rating	760 (103)	759 (102.9)	751 (101.8)	---	
Takeoff	682 (92.5)	--	718 (97.3)	708 (96.0)	
Maximum continuous	682 (92.5)	--	718 (97.3)	708 (96.0)	
Max. over-torque (transient ≤ 20 sec)	--	--	975 (132.2)	989 (134.2)	
30-minute rating			718 (97.3)	708 (96.0)	

NOTE 4.

FUEL AND OIL PRESSURE LIMITS

<p>A. FUEL PRESSURE, at engine inlet</p> <p>A. Minimum fuel pressure</p> <p>1. Normal operation, excluding starting phase, the minimum (absolute) pressure is defined by the highest of the following conditions:</p> <ul style="list-style-type: none"> 2.9 PSIA (20kPa) 35% of atmospheric pressure, 1 PSI (7 kPa) above the vapor pressure of the fuel used, Fuel pressure corresponding to a vapor volume over Liquid volume ratio of 0.30 <p>For Arriel 2D: Refer to Installation / Operating Manual</p> <p>2. During the starting phase or at relight, fuel pressure (relative) must not be less than:</p> <ul style="list-style-type: none"> -3.6 PSIG (-25 kPa) for the 2S1 -2.9 PSIG (-20 kPa) for the 2S2 +3.6 PSIG (+25 kPa) for the 2B, 2B1, 2C, 2C1, 2C2 and 2D <p>B. Maximum fuel pressure:</p> <ul style="list-style-type: none"> Less than or equal to 21.8 PSIG (150 kPa) (relative pressure) in all operating phases, for all Models except Arriel 2D Less than or equal to 26.1 PSIG (180kPa) (relative pressure), in all operating phases, for Arriel 2D
<p>B. OIL PRESSURE,</p> <p>1. Minimum Oil Pressure (relative):</p> <ul style="list-style-type: none"> For 2S1, 2B, 2B1, 2C and 2C1: 16.0 PSIG (110 kPa) For 2C2 and 2S2: 24.7 PSIG (170 kPa) For 2D: Refer to Installation / Operating Manual <p>2. Maximum Oil Pressure (relative):</p> <ul style="list-style-type: none"> For 2S1, 2S2, 2B, 2B1, 2C, 2C1 and 2C2: 87.0 PSIG (600 kPa) For 2D: Refer to Installation / Operating Manual

NOTE 5.

MAXIMUM PERMISSIBLE AIR BLEED FROM CENTRIFUGAL COMPRESSOR PLENUM

Maximum air mass flow: 0.22 lb/sec for all Models except Arriel 2D
 Maximum air mass flow: 0.33 lb/sec for Arriel 2D
 Power loss due to air bleed: Refer to Performance Booklet

NOTE 6.**AIR INTAKE REQUIREMENTS**

The ARRIEL engines have not been tested to evaluate the effects of foreign object ingestion other than rain water. Foreign object ingestion characteristics of airframe air inlet and engine combination are to be evaluated prior to approval of the engine installation, for all remaining foreign objects.

The ARRIEL engines do not have anti-icing provisions and have not been tested to evaluate the effects of icing conditions. Anti-icing characteristics of airframe, air inlet, and engine combination are to be evaluated prior to approval of the engine installation.

The ARRIEL 2S1 engine meets the requirements of FAR 33.68(a) and (b) when installed with Sikorsky S76C+ helicopter air intake assembly Part Number (P/N) 76300-07761-101.

The helicopter air intake design shall be such as to prevent instantaneous ingestion of ice, snow and water in excess of maximum quantities defined in the Installation and Operating Manual.

A protective grid, as defined in the Installation and Operating Manual shall be installed to limit the ingestion of foreign matter in the engine.

The Arriel 2B, 2B1 and 2D are not approved for operation in icing conditions with Eurocopter AS 350 B3 / EC 130 sand filter P/N 704 A 41 650 010.

AIR INTAKE REQUIREMENTS

The ARRIEL 2S2 engine meets the requirements of FAR 33.68(a) and (b) when installed with Sikorsky S76C++ helicopter air intake assembly P/N 041277880, barrier filter P/N 76302-07800, inlet bellmouth P/N 76304-07009-049 and heated duct P/N 0401277880.

The Arriel 2B and 2D engines meet the requirements of FAR 33.68(a) and (b) when installed with Eurocopter AS 350 B3 helicopter air intake P/N 350.A.54.1080.04 and protection screen P/N 350.A.58.1607.03. The engines are not approved for operation in icing conditions with Eurocopter AS 350 B3 sand filter P/N 704.A.41.650.010.

The Arriel 2B1 and 2D engines meet the requirements of FAR 33.68(a) and (b) when installed with Eurocopter EC 130 helicopter air intake P/N 350.A.54.1080.04 and protection screen 350.A.58.1607.03. The engines are not approved for operation in icing conditions with Eurocopter EC 130 sand filter P/N 704.A.41.650.010.

The Arriel 2C and 2C1 engines meet the requirements of FAR 33.68(a)(b) when installed with Eurocopter AS 365 N3 helicopter air intake ducts consisting of P/N 365.A.24.0110.04/05 (MGB section, left/right sides respectively) and P/N 365.A.54.5022.01 (engine compartment section, both sides), along with protection screen P/N 365.A.24.1067.02/03 (left/right sides respectively).

The 2B, 2B1, and 2D installation is approved for single-engine application only.

The 2C, 2C1, 2C2, 2S1, and 2S2 engine models are restricted to multi-engine helicopter applications.

NOTE 7.**ACCESSORY DRIVE PROVISIONS**

Designation	Direction* Of Rotation	Rotation Speed rpm	Maximum Torque in Overload (in-lb)	Maximum Static Overhang (in-lb)	Fuse Shaft Breakaway Torque (in-lb)	Maximum Permanent Shaft Power(SHP)	
						Twin engine	OEI situation
Starter-generator	CW	11330	443	221	841	10.1	10.1
2S1						4.7	10.1
2S2						4.7	6.7
2C/2C1						6.7	6.7
2C2						10.1 (single engine)	
2B/2B1 2D						12.1 (single engine)	
Oil cooling fan output drive:	CCW	12253	89	133	885	2.0	2.0
2S1/2S2						2.0	2.0
2C2						2.0	2.0

For Accessories:							
Oil pump pack	CW	11883					
HP fuel pump							
LP fuel pump	CCW	11883					
Control system Alternator	CCW	12180					
*CW: clockwise; CCW: counterclockwise. The rotation direction of the power drives for the accessories is indicated considering the power drive seen from the outside. The rotation direction of the engine rotors is indicated with respect to viewing the engine from its rear end. For further details see Installation Manual.							
Oil cooling fan output drive is available on 2S1 and 2C2 only.							

NOTE 8.**ENGINE RATINGS**

Engine ratings are based on calibrated test rig with performance under the following conditions:

Static, sea level standard conditions (59 F, 29.92" Hg)

No airbleed, no accessory power extraction

6,409 RPM output shaft drive speed for 2S1 and 2S2

6,000 RPM output shaft drive speed for 2B/2B1, 2C, 2C2, and 2D

Fuel load heat value = 18,545 BTU/lb

The ratings given above are minimum final test performance of production and overhaul engines in accordance with engine acceptance test specification:

No. 0.292.02.941.0 for 2S1

No. 0.292.02.945.0 for 2B

No. 0.292.02.949.0 for 2B1

No. 0.292.02.944.0 for 2C

No. 0.292.02.948.0 for 2C1

No. 0.292.02952.0 for 2C2

No. 0.292.02953.0 for 2S2

No. AA049722 for 2D

Use the exhaust pipe specified below with calibrated test bed air intake No. 6.528.12.500.0 for 2S1, 2B, 2B1, 2C, and 2C1 and No. 6.528.12.501.0 for 2C2, 2S2 and 2D.

Exhaust pipe No. 0.292.81.500.0 is part of the engine definition (primary exhaust pipe), and is common to the 2S1, 2B, 2B1, 2C, and 2C1.

Exhaust pipe No. 0.292.81.502.0 is part of the engine definition (primary exhaust pipe), and is common to the 2S2 and 2C2.

Exhaust pipe No. 0.292.81.047.0 is part of the Arriel 2D engine definition (primary exhaust pipe)

NOTE 9.**FUEL SUPPLY REQUIREMENTS**

The ARRIEL 2S1, 2S2, 2B, 2B1, 2C, 2C1, 2C2 and 2D have a fuel filter supplied with the engine.

Use of anti-icing additive for fuel temperature: < -20°C for Arriel 2B, 2B1, 2C, 2D, 2C1, and 2S1.

< 30°C for Arriel 2C2 and 2S2

NOTE 10.

OIL SYSTEM: Refer to Installation Manual.

NOTE 11.

ENGINE MONITORING TRANSMITTERS: Refer to Installation Manual.

NOTE 12.**CONTROL SYSTEM:**

Single channel electronic engine control system with manual backup for 2S1, 2B, and 2C.

Dual channel electronic engine control system with optional auxiliary backup control for 2B1, 2C1, 2C2 and 2S2.

Dual channel electronic engine control system with auxiliary back-up control for 2D.

NOTE 13.**ENGINE FIRE DETECTOR**

The ARRIEL 2S1 and 2S2 have no fire detectors installed on the engine.

The Arriel 2B, 2B1, 2C, 2C1 and 2C2 feature mounting and wiring for installation of three fire detectors. Fire detectors are not part of the engine definition.

The Arriel 2D feature mounting and wiring for installation of three fire detectors. Fire detectors are part of the engine definition.

NOTE 14.

Refer to Installation Manual for approved oil specifications.

NOTE 15.

Refer to Installation Manual for approved fuel and additive specification.

NOTE 16.

Life-limited components are listed in EASA-approved Airworthiness Limitations Section (Chapter 5) of the engine Maintenance Manual.

NOTE 17.

Permissible overhaul and inspection intervals are listed in EASA- approved Airworthiness Limitations Section (Chapter 5) of the engine Maintenance Manual.

NOTE 18.**MANUALS REQUIRED BY FAR 33.5**

	Performance Manual No.	Installation Manual No.	Operation Manual No.	Maintenance Manual No.	Repair Manual No.
ARRIEL 2S1	X 292 L0 001 9	X 292 L0 001 1	See Note 19	X 292 L0 301 2	X 292 L0 500 2
ARRIEL 2B	X 292 M5 001 9	X 292 M0 001 2	See Note 19	X 292 M5 450 2	---
ARRIEL 2B1	X 292 N5 002 9	X 292 N5 001 9	See Note 19	X 292 N5 450 2	---
ARRIEL 2C	X 292 M1 001 9	X 292 M1 001 2	See Note 19	X 292 M1 450 2	---
ARRIEL 2C1	X 292 N4 002 9	X 292 N4 001 2	See Note 19	X 292 N4 450 2	---
ARRIEL 2C2	X 292 N6 002 9	X 292 N6 404 1	See Note 19	X 292 N6 450 2	---
ARRIEL 2S2	X 292 P5 001 9	X 292 P5 001 2	See Note 19	X 292 P5 451 2	X 292 P5 550 2
ARRIEL 2D	AA049088	X 292 R1 001 2	See Note 19	X 292 R1 450 2	X 292 R1 500 2

NOTE 19.

The Operation Manual is contained within Chapter 15 of the Installation Manual.

NOTE 20.

Overhaul of Arriel engine components is not authorized until the overhaul manual becomes available. In the interim, Turbomeca, France may overhaul the engine.

NOTE 21.

Each of the documents listed below must state that it is approved by the European Aviation Safety Agency (EASA) or, for approvals made before September 28, 2003 by the Direction Generale de L'Aviation Civile (DGAC). Any such documents including those approved under a delegated authority, are accepted by the FAA and are considered FAA accepted.

- Service bulletins,
- Structural repair manuals,
- Vendor manuals,
- Aircraft flight manuals, and
- Overhaul and maintenance manuals.

These approvals pertain to the type design only.

NOTE 22.

The Models shown on this TCDS have the following general characteristics:

MODELS**CHARACTERISTICS**

ARRIEL 2S1

Base Model

ARRIEL 2B

Similar to ARRIEL 2S1. The rating structure is simplified for single engine application: Takeoff and Maximum Continuous ratings only. The main differences are the mounts, provision for the tail rotor drive, and the deletion of the oil cooler fan drive on the reduction gearbox.

ARRIEL 2B1

Similar to ARRIEL 2B. The main difference is the dual channel electronic engine control system.

ARRIEL 2C

Similar to ARRIEL 2S1. The main differences are the mounts and the deletion of the oil cooler fan drive on the reduction gearbox.

ARRIEL 2C1	Similar to ARRIEL 2C. The main difference is the dual channel electronic engine control system.
ARRIEL 2C2	Similar to engine ARRIEL 2C1, main differences being the increased power ratings, (thermal and torque) the HIP/SARM rating (similar to 2S1), new HPT material and new axial compressor wheel.
ARRIEL 2S2	Similar to the ARRIEL 2S1. The main differences are a control system with a dual channel FADEC with mechanical back-up, increased power ratings and new HPT blade material and new axial compressor wheel (similar to 2C2).
ARRIEL 2D	Similar to the ARRIEL 2C2. The main differences are: it is a single-engine application that has a 30-minute Take-off Power Rating, new dual channel electronic control system, new power turbine rear bearing support with new containment ring, new power turbine blade profile, and engine mounts identical to those of the Arriel 2B/2B1.

NOTE 23. Operators who use the 30-minute power rating must comply with the airworthiness limitations (if any) as specified in the ARRIEL 2S1 Maintenance Manual X 292 L0 301 2, Volume 1, Chapter 0; , ARRIEL 2C2 Maintenance Manual X 292 L0 301 2, Volume 1, Chapter 0; ARRIEL 2S2 Maintenance Manual X 292 P5 451 2, Volume 1, Chapter 0; and ARRIEL 2D Maintenance Manual X 292 R1 450 2.

NOTE 24

DISPATCH LIMITATIONS:

ARRIEL 2B, 2B1, 2C, 2C1, 2C2 and 2S2: All engine systems and equipment must be functional prior to aircraft take-off. Any engine system or equipment malfunction, which occurs during flight, must be repaired prior to the next flight.

ARRIEL 2S1: The engine is approved to operate with certain faults present in the control system, based on satisfaction of FAR 33 requirements and appropriate control system reliability requirements. Criteria pertaining to the dispatch and maintenance requirements for the engine control system are specified in the Installation Manual. The airframe manufacturers may use different nomenclature in adapting these fault categories to the aircraft maintenance and display systems; however, the maximum operating intervals are restricted as defined in the Installation Manual.

Arriel 2D: An Engine Dispatch Configuration analysis has been performed and is referenced in the Installation Manual.

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